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Competition Among Hospitals: Market Structure and Its Relation to Utilization, Costs and Financial Position

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Hospital Cost and Utilization Project
Research Note

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Background

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Additional information on the Hospital Studies Program and the Hospital Cost and Utilization Project is available from the National Center for Health Services Research and Health Care Technology Assessment, 3-50 Park Building, Rockville, MD 20857; 301/443-5706.

Copies of the Hospital Studies Program publications are available from the NCHSR Publications and Information Branch, 1-46 Park Building, Rockville, MD 20857; 301/443-4100.

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HCUP Research Notes are derived from research conducted by members of the Hospital Cost and Utilization Project (HCUP), a component of the Hospital Studies Program, Division of Intramural Research, National Center for Health Services Research and Health Care Technology Assessment. This series provides information from HCUP research to administrators, policymakers, health care professionals, and researchers on important issues related to hospitals.

Overview

Goals of the Hospital Study Program are to help understand how hospitals provide health care services and to determine patterns of hospital use and costs. HCUP is specifically designed to use national data to provide information and analyses on research and policy questions pertaining to the performance of the hospital industry. Issues already addressed or to be addressed in forthcoming studies include:

- How does competition among hospitals influence costs, case mix, length of stay, and surgical rates?
- Why do length of stay and use of ancillary services vary across hospitals and over time, both overall and for specific diseases?
- Why do rates of specific surgical procedures, such as cesarean sections and coronary artery bypass, vary across hospitals?
- Do hospitals shift unreimbursed costs of patients covered by Medicare and Medicaid to patients covered by private insurance?
- Do procedures, services and diagnoses vary across specific groups of patients?
- To what degree does medical staff specialization affect the mix and length of stay of hospital patients?
- Do larger hospitals treat different types of patients and have lower costs per patient for specific diagnoses than smaller hospitals?

Data base

Nearly 400 of the more than 5,500 short-term, general, non-Federal hospitals in the United States are included in the Hospital Cost and Utilization Project. These hospitals were selected according to scientific sampling procedures to represent the range of factors influencing hospital behavior, utilization, and costs. Participation in the study was voluntary, but hospitals with incomplete discharge abstract data files, in terms either of information or period of coverage, were not included in the sample.

Data were acquired from a number of published and unpublished sources. Information on patient clinical status and use of inpatient services was obtained from hospital discharge abstracts provided by 12 major discharge abstract services. Patient data cover more than 20 million discharges from 1970 through 1977 for national sample hospitals. NCHSR is now collecting similar data for 1980 through 1984, and will eventually obtain information through 1987.

Information on characteristics of each hospital was obtained from the American Hospital Association's Annual Survey of Hospitals, various Special Surveys conducted by the American Hospital Association, and each hospital's annual Medicare Cost Report. Data on medical staff characteristics of a subsample of hospitals were obtained from the American Medical Association's Masterfile of U.S. Physicians. Characteristics of the community in which each hospital is located were obtained from the Area Resource File, compiled by the Bureau of Health Professions, Health Resources and Services Administration, U.S. Department of Health and Human Services.

The HCUP data files represent a unique linkage of hospital, patient, physician, and community information for a large sample of hospitals from 1970 to 1977. The data base, augmented with information for the 1980s, will permit comprehensive assessment of factors affecting patterns of hospital use and costs.

Data files for HCUP were constructed under the technical direction of NCHSR by SysteMetrics, Inc., of Santa Barbara, California (funded by contract OASH 233-78-3001), and by Mandex, Inc., of Vienna, Virginia (funded by contract OASH 233-81-3030).

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Competition Among Hospitals: Market Structure and Its Relation to Utilization, Costs and Financial Position

Dean E. Farley

During the last few years, researchers and policymakers have become increasingly interested in using competition to restrain the rising costs of health services. Advocates of this strategy argue that consumers will more forcefully demand value for their money if they must pay larger portions of their medical bills, especially if consumers have access to alternative insurance plans and sources of care.[1] Proponents of competition believe that it will reduce the escalation of health care prices and generate significant structural reforms within the industry.[2]

Although recent "procompetitive" proposals typically call for establishing competitive markets for health services, they are more accurately described as restructuring competitive processes. There is in fact a long history of competitive relationships among physicians, hospitals and insurers. Earlier competition largely emphasized quality of care, service intensity and resource availability. More recent proposals seek to change institutional relationships and incentives so that decisionmakers will focus on the price of medical services in choosing what, how, and from whom to buy.

Existing limited empirical evidence suggests that nonprice competition has been an important determinant of hospitals' market behavior. For example, Joskow (1980) found that excess bed capacity, typically assumed to measure one dimension of quality, was greater in competitive markets. Farley (1982) reported that various types of hospital investment appear to be associated with the number and size of rival institutions.

This report extends such findings by examining a broad range of hospital characteristics on a national level in relation to the structure of local hospital markets. The next section discusses the nature of competition among hospitals and the applicability of traditional economic theory to hospital behavior. Following descriptions of the data and the analytical approach, the paper presents statistical measures of the relationships between competition and hospitals' revenues and costs, case mix, utilization and resources. Results indicate that competition increased the cost and service intensity of hospital services from 1970 to 1977. They also indicate that hospitals' charges were adjusted to accommodate competition-related variations in costs, a pattern that one would not observe in a price-competitive market.

This analysis does not examine the effects of recent developments that presumably make hospital markets more sensitive to price. These include such arrangements as HMOs, PPOs, IPAs and other prudent-purchasing organizations. The data used here are drawn from a time period when more traditional relationships were pervasive.

The analysis presented below serves two primary purposes. It characterizes incentives and their effects that once dominated the hospital industry and that continue to have substantial influences on providers and their behavior. Without exploring these effects, it will be difficult to evaluate the impact of more recent developments

[1] Havighurst (1978), Ginsburg (1981) and Frech (1981). Both Langwell and Moore (1982) and Pauly and Langwell (1982) provide excellent discussions of this general issue.

[2] Enthoven (1978), Stockman (1980).

and to understand how they may alter preexisting incentives. Consequently, the second purpose of this analysis is to establish baselines with which to assess new price-competitive institutional arrangements.

What is hospital competition?

The notion that competition leads to efficiently allocated resources is based on the theoretical role of prices in smoothly functioning markets. It presumes that the price consumers offer to pay for a service indicates the value they attach to its consumption and that profit-oriented producers provide those goods and services that earn the best return, *i.e.* the largest difference between price and cost. As a result, consumers tell producers what they want by the price they are willing to pay and producers inform consumers about what they can have through the price they are willing to accept.

In theory, competition ensures those two prices are the same. As different producers attempt to sell in a market, they must offer consumers better "deals" by lowering their prices. Indeed, economists usually assume that consumers are fully informed about the prices and quality available from different firms so that they are always able to acquire the most value for their dollars. Competition therefore forces firms to lower their prices to the point where costs, including capital requirements, are just being met. The resulting consonance between consumers' valuation of services and the cost of producing them is generally thought to be an appropriate guide to the flow and use of resources in a competitive economy.

The desirability of competition among hospitals is a matter of debate. Critics cite at least three ways in which the industry deviates from theoretical ideals. First, and perhaps most important, is the pervasiveness of health insurance coverage. This breaks the link between the value consumers attach to a product, as measured by the price they are willing to pay, and the price received by providers. In addition, many insurers reimburse hospitals on the basis of the cost of their services, especially during the time period examined below. This practice, known as "cost-based reimbursement," reduces hospitals' incentives to produce efficiently and to respond to preferences expressed through the price mechanism.

A second issue is the not-for-profit organization of most hospitals. The theory of competition generally assumes that firms want to maximize profits. This goal causes them to focus on prices and costs as the basis for economic decisionmaking. It is far from clear whether firms with other objectives will operate efficiently, establish prices at the limit of what the market will bear, and respond effectively to consumers' individual preferences.

The third issue is the role of physicians in the market for hospital care. Doctors serve as intermediaries between hospitals and patients while they simultaneously pursue their own economic and professional interests. Doctors play so dominant a role in this market that several analysts have argued that competition is really based on the need to attract physicians to hospitals.[3] Because phy-

[3] Harris (1977), Silvers (1977), Farley (1982), Pauly and Langwell (1982).

sicians' interests are clearly served by large quantities of hospital-based resources, such competition tends to increase the resource-intensity of hospital care.

It is reasonable, although somewhat simplistic, to view hospitals as competing in terms of both their pricing policy and their hiring and investment decisions. Economists generally assume that the first of these dimensions is the primary basis for competition in more traditional industries. As described above, firms want to set their prices as high as possible to maximize their profits, but higher prices lower demand as consumers reduce their purchases and buy from other, lower-cost suppliers. Competition forces prices down and thereby lowers profit margins.

However, the characteristics of the hospital industry tend to shift the focus of competition away from charges and onto hiring and investment decisions. Health insurance enables patients to receive the full value of resources acquired by a facility while paying only a portion of the corresponding cost. Moreover, the not-for-profit status of most hospitals may encourage them to set prices below what the market would bear as a community service or to generate goodwill within its service area. Indeed, public hospitals can establish charges below costs and rely on tax revenues to subsidize their operations. In addition, it seems likely that many doctors will be influenced more by medical considerations than by prices in advising their patients.

Theories of nonprice competition are considerably less developed than models used to analyze pricing behavior. It seems clear that hospitals make themselves more attractive to both patients and physicians, compared to their rivals, by hiring additional staff and expanding their physical plants. This enables them to care for more patients, treat a wider variety of conditions and provide higher quality services. Physicians also benefit because they can use these additional resources to expand their medical practices. Yet, the employment and investment decisions of a hospital must be reflected in its pricing policy. Because most institutions cannot afford to set their charges below cost indefinitely, additional labor and capital eventually will cause a hospital to increase its charges.

Personnel, equipment and beds influence the output of a hospital in two ways. They affect the number of patients a doctor can treat, the quality of service rendered to patients and the range of conditions for which a physician can admit patients to an institution. They also affect the number of people seeking services from a hospital and the size of its medical staff because both patients and physicians are attracted to large, well-equipped and thoroughly staffed hospitals. In other words, resource availability influences both the productivity of individual doctors and the market share of a hospital.

To illustrate how competition might affect resource intensity, consider the relationship between the resources and volume of services in two hospitals: one located in a large urban area and another in a rural area without substantial competition. The market share of the rural hospital cannot change, by definition, so that additional personnel, equipment and beds only affect physicians' productivity. In contrast, additional resources acquired by the urban hospital alter both its market share and the productivity of its physicians. Consequently, the marginal value of resources to a hospital may be greater in competitive markets, thereby encouraging more resource-intensive hospital care.

However, even though additional resources may have a larger impact on the overall volume of care in competitive hospitals, it is not clear whether competition stimulates greater resource intensity. This ambiguity results from uncertainties about the institutional objectives of hospitals and from the interaction between price and nonprice competition. For example, some analysts have argued that hospitals value quality and technological sophistication, *per se*.[4] If a hospital like this were operating in a "monopolistic" market, it could indulge its preference for additional personnel and equipment and raise its charges to cover the additional costs more than if it operated in a competitive environment. However, if a hospital were interested in hiring more labor and acquiring more capital facilities primarily because they increase the demand for its services, it might well provide a more resource-intensive product in a competitive market, especially if it also wants to maintain relatively low charges. In view of this ambiguity, one role of the analysis presented below is to identify empirically testable hypotheses about the overall effects of competition among hospitals.

Data and analytical approach

This analysis uses data collected by the Hospital Cost and Utilization Project (HCUP), part of the Hospital Studies Program in the National Center for Health Services Research and Health Care Technology Assessment (NCHSR). This source contains observations from 1970 to 1977 on nearly 400 short-term, general, non-Federal hospitals in the United States, selected according to sampling procedures that maximize variations in hospital characteristics. Participation in the study was voluntary, but hospitals with incomplete discharge abstract data were omitted. Data were drawn from several sources. Information on basic hospital characteristics was taken from the American Hospital Association's Annual Survey of Hospitals. Financial information was obtained from each hospital's Medicare Cost Report. Patient clinical status and use of services were tabulated from hospital discharge abstracts provided by 12 discharge abstract services. Thus, HCUP data facilitate analyses of the relationship between competition and an unusually broad range of institutional characteristics.[5]

The analysis focuses on three aspects of hospital behavior: finances, case mix and utilization, and resource availability. Financial variables include measures of profitability, the costs of services and the revenues received by hospitals. Case mix and utilization involve the diagnostic composition of hospitals' case loads, average lengths of stay, and rates of procedures controlling for diagnosis. Resource availability describes the beds, equipment and employees present in hospitals. Table 1 summarizes the definitions, means and standard deviations of variables used in this analysis.

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[4] Newhouse (1970), Feldstein (1977).

[5] The Technical Notes in Coffey (1983) document the representativeness of the HCUP Hospital Sample.

To analyze the effects of competition, each hospital in the HCUP sample was assigned to one of three groups, depending upon the number and size of the short-term, general, non-Federal institutions operating in its county. This classification used a Herfindahl Index, a standard method for measuring the degree of competition in a market that has been employed successfully in other studies of hospital behavior.[6] Institutions operating in counties with only one community hospital were designated as "monopolistic." Hospitals operating in counties with a large number of institutions were classified as "competitive." In general, these areas had at least five or six similarly sized facilities. All other institutions were assigned to an intermediate category. Because the appropriate dimensions of "competitiveness" are not clear, data analysis was restricted to comparing characteristics of the two polar groups.

The entire HCUP sample also was divided into 64 cells based upon the regional location of each hospital, whether its county was part of a Standard Metropolitan Statistical Area, and the year to which its data pertain. Means were calculated for each cell and variables were reexpressed as deviations from these "adjusted means." The purpose of this transformation was to control for factors that are obviously related to the performance characteristics of hospitals (region, urban-rural status, and year), but that are not causally associated with market structure.

Controlling for urban-rural status is especially important. Farley (1985) demonstrates that rural hospitals differ from urban facilities along many of the dimensions considered here. Rural hospitals employ less labor and capital, have shorter lengths of stay, maintain fewer services and have lower costs per admission. Kelly and O'Brien (1983) similarly document a greater incidence of financial distress among rural institutions. Many of these results can be explained by the smaller size of rural hospitals and by differences in the populations they serve. Unfortunately, rural counties also tend to have fewer hospitals; this correlation must be addressed in examining competitive impacts. The statistical technique employed here is conservative in the sense that systematic differences associated with rural location are expunged from the data prior to examining distinctions based solely upon market structure.

It also is necessary to allow for differences in competitive impacts based upon hospital control because ownership may influence institutional objectives. For example, price competition may have the largest effect on the profit margins of proprietary hospitals because these facilities may be most likely to pursue aggressive pricing behavior in the absence of competition. Public hospitals may be most sensitive to political concerns and, therefore, the least responsive to market forces. Consequently, average deviations from the group means for hospitals in monopolistic and competitive markets were calculated separately for each type of hospital control. Competitive-monopolistic differentials then were es-

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[6] Joskow (1980), Farley (1982). The Technical Notes contain a more complete discussion of the Herfindahl Index.

Table 1. Definitions, means and standard deviations of variables used in analysis of hospital competition (HCUP Hospital Sample, 1977).

	Overall mean	Standard deviation
Profit-related variables		
Gross profit margin. Deviation of gross patient revenue (charges) from operating expenses as a percent of expenses.	9.37	13.33
Net profit margin. Deviation of net patient revenue (charges less deductibles) from operating expenses, as a percent of expenses.	-2.04	10.92
Aggregate profit margin. Net income or loss from operations as a percent of operating expenses.	2.39	9.16
Operating expenses per adjusted admission. Total operating expenses (in $1,000s) divided by admissions adjusted for outpatient visits.	5.97	3.23
Gross revenue per adjusted admission. Gross patient charges (in $1,000s) divided by admissions adjusted for outpatient visits.	6.61	3.73
Aggregate case-mix measures		
Short-term length of stay. Ratio of short-term inpatient days to short-term admissions.	7.65	2.69
Operations per short-term admission. Ratio of total surgical procedures to short-term admissions.	0.47	0.23
Case-mix index. Laspeyre's index of admitting diagnoses (see Technical Notes section).	108.9	18.8
Specific case-mix measures		
Number of admission attributable to specific diagnoses as a percent of total admissions.		
Acute myocardial infarction	1.30	0.74
Normal delivery	5.41	3.37
Fracture (all sites)	3.29	1.40
Bacterial pneumonia	2.14	1.63
Case-specific service intensity		
Mean number of reported procedures per admission due to specific diagnoses.		
Acute myocardial infarction	0.34	0.40
Normal delivery	1.13	0.36
Fracture (all sites)	1.26	0.49
Bacterial pneumonia	0.33	0.36
Resources available in hospital		
Average excess short-term bed capacity. Deviation of short-term beds from daily census by square root of average daily census.	4.35	2.29
Number of diagnostic and therapeutic services. Number of separately organized diagnostic and therapeutic services reported to AHA.	16.18	8.70
Net assets per adjusted admission. Ratio of long-term assets (in $1,000s), net of depreciation, to adjusted admissions.	5.10	4.02
FTE employees per adjusted admission. Ratio of AHA-defined full-time equivalents to adjusted admissions.	0.063	0.024
Capital-labor ratio. Ratio of gross long-term assets (in $1,000s) to FTE employees.	80.44	41.55

Source: National Center for Health Services Research and Health Care Technology Assessment. Hospital Studies Program.

tablished for each ownership class. An aggregate measure of the impact of competition was created by taking a weighted average of these differentials across ownership classes.[7]

Results

Financial characteristics. Table 2 summarizes the relationship between market structure and profitability, expenses and revenues. It indicates no statistically significant overall differences in profit margins associated with market structure. The net operating and aggregate profit margins of public hospitals are lower in competitive areas than in monopolistic markets, but there is little market-related variation in the profitability of voluntary hospitals. The latter represent the preponderance of institutions in the industry and the overall results are driven by their behavior.

Profit represents the difference between revenues and costs. The absence of any substantial relationship between competition and profitability conceals striking market-related variation in these two components. Operating expenses per adjusted admission are nearly 19 percent higher in competitive markets. Ordinarily, higher costs would reduce profits, but the diminished role of price competition and the prevalence of cost-based reimbursement apparently mean that hospitals recoup these additional costs by raising their charges. Thus, the 19 percent cost differential is more than offset by an average 20 percent increase in gross revenue per adjusted admission.[8]

Differentials in expenses and revenues depend upon the type of hospital control. The lower rates of return earned in competitive markets by public hospitals are the result of large increases in costs that are not entirely offset by additional revenues. In particular, the cost per adjusted admission is approximately 50 percent higher for public hospitals than for voluntaries, while the difference in gross revenues for public hospitals is somewhat less than for other institutions.

Although these results seem to suggest that competition imposes financial penalties on public hospitals, one must be cautions about evaluating the financial performance of public hospitals on the basis of their accounting profitability. Coffey (1983) argues that there are fundamental differences between public facilities located in rural areas and those in metropolitan centers. Non-SMSA public hospitals are often operated by independent hospital authorities created especially to provide inpatient services in the absence of other hospitals. As such, they seem to function like private, not-for-profit institutions in similar locations. Urban public hospitals are nearly always operated by municipal authorities in direct competition with private hospitals. They are known to care for relatively large numbers of indigent patients and may deliberately establish charges below operating costs, relying on tax subsidies to balance their budgets. Tax dollars used to defray the operating losses of public hospitals may not be captured fully by the measures of revenue used in this analysis.

[7] Although the results of this analysis are presented as a comparison between competitive and monopolistic hospitals, the analytical approach uses data from all hospitals. Institutions that are neither competitive nor monopolistic are used to help control for region, year, urban-rural location and type of hospital control. Because of the small number of monopolistic proprietary hospitals in the HCUP Sample, separate results are presented only for public and private not-for-profit hospitals. The Technical Notes provide greater detail regarding cell sizes.

[8] Gross revenue measures a hospital's charges and must therefore increase more than expenses for profit margins to remain constant because of contractual allowances, bad debts and other deductions from revenue.

Table 2. Selected financial characteristics of hospitals by type of market and hospital control, with estimated standard errors in parentheses (HCUP Hospital Sample, 1970-1977).

		Average percent deviation[a] from adjusted means by structure of market			
Characteristic	Control	Competitive	Monopolistic	Market-related differential	Combined differential
Gross operating profit margin[c]	Public	-7.16[b] (1.97)	-4.10 (0.96)	-3.05 (2.19)	0.52 (0.79)
	Voluntary	-0.15 (0.48)	-1.07 (0.70)	0.91 (0.85)	
Net operating profit margin[c]	Public	-15.87[b] (2.57)	-2.71 (0.63)	-12.98** (2.65)	-0.98 (0.51)
	Voluntary	-0.17 (0.32)	-0.10 (0.41)	-0.23 (0.52)	
Aggregate profit margin[c]	Public	-3.46[b] (1.86)	-0.08 (0.54)	-3.55* (1.89)	-0.26 (0.49)
	Voluntary	-0.22 (0.22)	-0.31 (0.45)	0.09 (0.50)	
Operating expenses per adjusted admission[d]	Public	22.39[b] (6.99)	-5.43 (2.20)	27.81*** (7.30)	18.87*** (2.99)
	Voluntary	17.56 (2.32)	-0.72 (2.13)	18.28*** (3.15)	
Gross revenue per adjusted admission[d]	Public	7.87 (6.86)	-9.74 (1.89)	17.61 (7.72)	20.28*** (2.20)
	Voluntary	18.50 (2.17)	-1.95 (1.91)	20.45*** (2.29)	

[a] Sample means are adjusted for year, region and SMSA status. [b] Estimates are based upon fewer than 30 degrees of freedom. See Technical Notes for details regarding sample sizes. [c] Entries indicate average absolute deviations from adjusted means. [d] Entries indicate average percent deviations from adjusted means. *Indicates a statistically significant difference at the .10 level in testing the hypothesis of no difference between the means of hospitals in competitive and monopolistic markets, using a standard two-tailed t-test. **Indicates a statistically significant difference at the .05 level. ***Indicates a statistically significant difference at the .01 level.

Source: National Center for Health Services Research and Health Care Technology Assessment. Hospital Studies Program.

It is possible that the cost of hospital care is higher in competitive areas for reasons other than the effects of competition in the market for hospital services. The differentials in Table 2 could reflect higher labor expenses in urban areas, differences in insurance coverage or other cost-increasing conditions. However, most of these effects should be controlled by the adjustments for urban-rural location. Moreover, significant differences are reported below in the use of procedures and the availability of resources in competitive hospitals that may well explain observed differences in their costs and revenues. This suggests that the higher costs in competitive markets are attributable to differences in the services provided in competitive hospitals and not simply to variations in price levels.

Case mix and utilization. There are at least two reasons why hospitals in competitive areas might have higher costs and charges per adjusted admission than institutions in single-facility markets based on medical considerations. Hospital case mix may differ

Table 3. Selected values of aggregate case-mix variables in hospitals by type of market and hospital control, with estimated standard errors in parentheses (HCUP Hospital Sample, 1970-1977).

Characteristic	Control	Average percent deviation[a] from adjusted means by structure of market		Market-related differential	Combined differential
		Competitive	Monopolistic		
LOS-weighted index of admitting diagnoses	Public	-1.87 (1.61)	0.80 (1.05)	-2.67 (1.92)	1.26 (1.33)
	Voluntary	-0.37 (0.66)	-2.14 (1.33)	1.77 (1.49)	
Mean short-term length of stay	Public	4.81 (2.21)	-0.61 (1.16)	5.41 ** (2.50)	6.41*** (1.15)
	Voluntary	6.37 (0.80)	-0.20 (0.99)	6.57 *** (1.27)	
Number of operations per short-term admission	Public	-26.67 (2.47)	-12.55 (2.86)	-14.12*** (3.78)	7.65*** (2.30)
	Voluntary	6.44 (1.08)	-8.83 (2.59)	15.27 *** (2.81)	

[a] Sample means are adjusted for year, region and SMSA status. See Technical Notes regarding sample sizes. *Indicates a statistically significant difference at the .10 level in testing the hypothesis of no difference between the means of hospitals in competitive and monopolistic markets, using a standard two-tailed t-test. **Indicates a statistically significant difference at the .05 level. ***Indicates a statistically significant difference at the .01 level.

Source: National Center for Health Services Research and Health Care Technology Assessment. Hospital Studies Program.

systematically across markets in such a way that institutions in competitive areas tend to treat more expensive conditions. Alternatively, similar medical conditions may receive more costly treatment in competitive markets. Thus, higher costs could reflect differences in either case mix or service intensity.

A priori, the effect of competition on the severity of illnesses treated by a hospital is not clear. If hospitals in competitive markets increase their volume by admitting patients that might otherwise be treated on an outpatient basis, the severity of their average illness should fall. Alternatively, competition based on factors other than price may cause hospitals to expand their medical capabilities. To the extent that this allows them to treat more difficult cases, severity may rise.

One dimension of a hospital's case mix is the diagnostic composition of its patients. The case-mix index presented in Table 3 characterizes this dimension on the basis of expected length of stay, relative to the overall sample average. As the value of this index increases, it implies that more patients are being admitted with diagnoses associated with longer lengths of stay.[9] Such cases are also presumably more costly to treat. According to Table 3, the relationship between this index and hospital competition is small and statistically insignificant regardless of hospital control. In other words, the diagnostic composition of patients should not explain any differences observed in length of stay across types of markets.

Consequently, it is interesting to find that average lengths of stay for short-term admissions are higher in competitive markets for all

[9] The construction of the case-mix index is described in the Technical Notes.

types of hospital control. This implies either that similar cases are being treated differently, depending upon the type of market, or that patients in competitive hospitals are more severely ill, even controlling for diagnosis.

Table 3 also indicates that voluntary hospitals perform 15 percent more surgery per short-term admission in competitive markets than in monopolistic areas, while public hospitals perform surgery 14 percent less often. One explanation for higher surgical rates is the presence of more severely ill patients, which might explain the cost of care in competitive areas. However, according to Table 2, expenses per adjusted admission are higher in both public and voluntary competitive hospitals, while surgical rates are only larger in the latter case. Consequently, costs appear to be higher in competitive markets because more resources are used to treat specific medical conditions.

The lower surgery rates for public hospitals in competitive markets may reflect some degree of specialization by diagnosis. Public hospitals may have less access to capital than private institutions and may therefore be at a disadvantage in competing for patients that require sophisticated equipment and facilities. Consequently, they may admit a relatively large number of medical patients under competitive conditions. Alternatively, public hospitals in competitive markets may serve special populations, as noted earlier. The medical problems they treat may simply require less surgery. It is also possible that their medical staffs are different from those of private institutions, either because of the resources they make available to physicians or because of the medical needs of their patients.

The cost of care may be high in urban hospitals because rural hospitals are not equipped to deal with complex medical problems. Instead, they refer patients with difficult conditions to urban medical centers with more extensive facilities. The results presented here neither support nor contradict this thesis because such behavior should be reflected in urban-rural differences between means, differentials for which the analysis controls. Rather, these findings suggest that costs may be higher in competitive markets because similar diagnoses are treated differently, depending upon the type of market in which a hospital operates.

To analyze diagnosis-specific patterns of utilization, four common admitting diagnoses were selected that together account for more than 12 percent of all hospitalizations: acute myocardial infarction, bacterial pneumonia, normal delivery, and fracture (all sites). Each is a well-defined condition with reasonably unambiguous criteria for deciding if hospitalization is indicated; this is particularly true for both acute myocardial infarction and normal delivery, where hospitalization is routine. In contrast, there is some discretion about the course of treatment for these diagnoses except for normal delivery, which is routinely treated and uncomplicated by definition.

Table 4 summarizes market-related differences in the fraction of total admissions attributable to these four diagnoses. With the exception of fractures, each accounts for smaller percentages of ad-

Table 4. Number of admissions for specific diagnoses as a percent of all admissions, by type of market and hospital control, with estimated standard errors in parentheses (HCUP Hospital Sample, 1970-1977).

Diagnosis	Control	Average percent deviation[a] from adjusted means by structure of market		Market-related differential	Combined differential
		Competitive	Monopolistic		
Acute myocardial infarction	Public	-25.93 (7.63)	4.74 (4.33)	-30.66*** (8.77)	-8.32** (3.96)
	Voluntary	0.23 (2.46)	4.05 (3.67)	-3.82 (4.42)	
Normal delivery	Public	18.87 (9.55)	11.28 (4.84)	7.59 (10.71)	-7.98** (3.67)
	Voluntary	-6.49 (2.79)	3.35 (2.72)	-9.84** (3.90)	
Fracture (all sites)	Public	42.48 (1.30)	-17.50 (2.75)	60.03*** (7.80)	3.34 (2.91)
	Voluntary	-9.96 (1.57)	-3.28 (2.71)	-6.68** (3.13)	
Bacterial pneumonia	Public	9.79 (7.09)	17.41 (7.24)	-7.62 (10.13)	-18.64*** (4.28)
	Voluntary	-18.26 (2.00)	5.16 (3.79)	-23.42*** (4.29)	

[a] Sample means are adjusted for year, region and SMSA status. See Technical Notes regarding sample sizes. *Indicates a statistically significant difference at the .10 level in testing the hypothesis of no difference between the means of hospitals in competitive and monopolistic markets, using a standard two-tailed t-test. **Indicates a statistically significant difference at the .05 level. ***Indicates a statistically significant difference at the .01 level.

Source: National Center for Health Services Research and Health Care Technology Assessment. Hospital Studies Program.

missions in competitive areas, suggesting that the mix of diagnoses treated in a hospital may be related to competitive pressures. Yet, Table 3 indicates no systematic differences in length of stay by type of market structure based on hospitals' diagnostic mixes. Using length of stay as an indicator of costliness, this means that the case mix of competitive hospitals is different from that of monopolistic facilities, but it is not necessarily more expensive.

The differences in the results between public and voluntary hospitals suggest some degree of diagnostic specialization in competitive markets. The proportion of acute myocardial infarction admissions to public institutions is larger in competitive markets, while the difference for voluntary hospitals is not statistically meaningful. Public hospitals maintain similar percentages of admissions for normal deliveries and bacterial pneumonia in competitive and monopolistic markets. However, these diagnoses account for smaller portions of the case load in voluntary hospitals operating in competitive markets.

The distinction between public and voluntary hospitals is even more pronounced in the case of fracture. Voluntary hospitals admit fewer such cases in competitive markets, relative to monopolistic areas, while public hospitals admit more. In fact, the public hospital differential is so large as to swamp the decline in private not-

Table 5. Mean number of procedures per admission for specific diagnoses, by type of market and hospital control, with estimated standard errors in parentheses (HCUP Hospital Sample, 1970-1977).

Diagnosis	Control	Average percent deviation[a] from adjusted means by structure of market: Competitive	Monopolistic	Market-related differential	Combined differential
Acute myocardial infarction	Public	27.38 (20.44)	-10.02 (11.27)	37.40 (23.34)	31.68*** (9.42)
	Voluntary	14.07 (4.01)	-16.04 (9.32)	30.11*** (10.15)	
Normal delivery	Public	12.35 (4.55)	4.34 (3.16)	8.01 (5.54)	1.38 (2.52)
	Voluntary	0.77 (1.37)	1.33 (2.47)	-0.56 (2.82)	
Fracture (all sites)	Public	8.33 (2.95)	-7.94 (4.04)	16.27*** (5.00)	10.07*** (3.07)
	Voluntary	3.13 (1.25)	-2.80 (3.68)	5.93 (3.89)	
Bacterial pneumonia	Public	24.66 (12.11)	-16.27 (9.72)	40.93*** (15.53)	27.76*** (7.94)
	Voluntary	15.32 (3.88)	-7.48 (8.37)	22.80** (9.23)	

[a] Sample means are adjusted for year, region and SMSA status. See Technical Notes regarding sample sizes. *Indicates a statistically significant difference at the .10 level in testing the hypothesis of no difference between the means of hospitals in competitive and monopolistic markets, using a standard two-tailed t-test. **Indicates a statistically significant difference at the .05 level. ***Indicates a statistically significant difference at the .01 level.

Source: National Center for Health Services Research and Health Care Technology Assessment. Hospital Studies Program.

for-profit hospitals. This results in an overall increase in the relative proportion of patients admitted for fracture in competitive markets, although this effect is not statistically significant. In general, these results confirm indications in Table 3 that public hospitals in competitive areas serve substantially different populations and provide a different set of services to their patients than private institutions in similar markets.

Table 5 contrasts the mean number of procedures performed per admission for the same four diagnoses included in Table 4. According to these data, roughly 30 percent more procedures are performed for admissions due to acute myocardial infarction and bacterial pneumonia in competitive areas than in monopolistic markets. Competitive hospitals average 10 percent more procedures for fractures. Only normal deliveries show no significant difference in this variable across markets, an expected result given the nature of the diagnosis.

As with other variables, however, the relationship between use of procedures and market structure depends upon hospital control. There is a significant competition-related increase in procedures per admission for fracture and bacterial pneumonia in public hospitals. For voluntary institutions, these increases exist for acute myocardial infarctions and bacterial pneumonia. The results for public and voluntary hospitals are similar only for admissions due to bacterial pneumonia.

Increases in the number of procedures performed per admission cannot be a direct result of hospital competition because this variable is determined primarily by physicians. It is difficult to argue that physicians' behavior is based on the number and relative size of hospitals in their locale. The higher diagnosis-specific procedure rates in competitive markets may be attributable to more acutely ill patients, particularly if the kinds of transfers described above occur in substantial numbers. However, the size of the differentials reported in Table 5 suggests there are also important market-related differences in courses of treatment. As such, they confirm the conclusions advanced on the basis of the more aggregate data in Table 3.

Resource availability. Resource intensity appears to be more important than case mix in explaining the relatively expensive hospital care provided in competitive markets. According to the results summarized in Table 6, competition is associated with increases in excess bed capacity as well as the number of facilities and services, assets and personnel found in hospitals. This explains the higher expenditures per adjusted admission found in Table 2 and the greater use of procedures discussed above. Such patterns are entirely consistent with the behavior one would expect to observe in markets dominated by nonprice competition.

The form that market-related differences in resource availability take varies by hospital control. The observed increase in excess bed capacity is consistent with previous findings by Joskow (1980) and Farley (1982). However, once the data are adjusted for regional, urban and time-related factors, most of this effect is found in public facilities. The increase in formally organized diagnostic and therapeutic services for public hospitals in competitive markets is four times that for voluntary hospitals. This can only be explained by differences across markets in the populations served by public hospitals, the means by which their services are extended to target populations, and the mix of diagnoses present in such hospitals.

The large number of organized services available in competitive public hospitals does not translate into substantial increases in their capital intensity. Relative to monopolistic markets, net assets per adjusted admission are only 3 percent higher for public facilities in competitive markets, compared with a difference of more than 12 percent for private hospitals. In contrast, there is nearly a 30 percent market-related increase in the labor usage of public hospitals. This is substantially more than the differential for voluntary hospitals, which averages approximately 10 percent more FTEs per adjusted admission in competitive markets, relative to monopolistic areas. Consequently, the capital-labor ratio of public hospitals declines as competition increases, while it is essentially invariant with respect to market structure in private, not-for-profit institutions.

Table 6. Selected measures of resources available in hospitals, by type of market and hospital control, with estimated standard errors in parentheses (HCUP Hospital Sample, 1970-1977).

		Average percent deviation[a] from adjusted means by structure of market			
Characteristic	Control	Competitive	Monopolistic	Market-related differential	Combined differential
Average excess short-term bed capacity	Public	18.91 (7.05)	1.85 (4.22)	17.06** (8.22)	5.99* (3.15)
	Voluntary	-3.76 (1.87)	-7.31 (2.83)	3.55 (3.39)	
Number of diagnostic and therapeutic services	Public	41.62 (5.55)	-5.63 (3.18)	47.25*** (6.40)	20.22*** (3.52)
	Voluntary	11.66 (1.41)	-0.38 (3.91)	12.04*** (4.15)	
Net assets per adjusted admission	Public	-0.01 (9.99)	-2.99 (4.85)	2.98 (11.11)	11.31* (5.88)
	Voluntary	16.20 (2.84)	3.79 (5.84)	12.41* (6.49)	
FTE employees per adjusted admission	Public	27.83 (6.41)	0.42 (1.86)	27.41*** (6.67)	11.61*** (1.91)
	Voluntary	12.33 (1.25)	2.09 (1.56)	10.24*** (1.99)	
Capital-labor ratio	Public	-28.08 (5.56)	-4.23 (3.49)	-23.84*** (6.57)	-2.00 (4.67)
	Voluntary	4.04 (2.10)	1.99 (4.11)	2.05 (4.61)	

[a] Sample means are adjusted for year, region and SMSA status. See Technical Notes regarding sample sizes. *Indicates a statistically significant difference at the .10 level in testing the hypothesis of no difference between the means of hospitals in competitive and monopolistic markets, using a standard two-tailed t-test. **Indicates a statistically significant difference at the .05 level. ***Indicates a statistically significant difference at the .01 level.

Source: National Center for Health Services Research and Health Care Technology Assessment. Hospital Studies Program.

Summary

There is considerable anecdotal evidence to suggest that hospitals have traditionally engaged in a variety of competitive practices to attract physicians and patients. In the past, price has not been a particularly effective competitive instrument because these parties are largely insulated from the cost of hospital care by existing insurance arrangements. Instead, it is widely believed that hospitals have used resource acquisition as the basis of their market behavior. This report presents descriptive empirical evidence about the implications of such rivalry and generally supports the conventional wisdom that hospital competition has increased costs.

By comparing characteristics of hospitals in competitive markets with those of similar institutions operating in single-hospital areas, this analysis isolates the effects of market structure on hospitals' behavior. Controlling for urban-rural status, year and regional locations, it demonstrates that competitive hospitals produce significantly more expensive medical care than other institutions. They tend to employ more capital and labor, maintain more organized services and perform more procedures, including surgery, for specific diagnoses. Their patients stay longer, but not long enough to eliminate significantly greater amounts of excess capacity. Yet, these differentials cannot be explained satisfactorily by the medical conditions of patients. Measured in terms of expected length of stay, there is little difference between the case mix of competitive and monopolistic hospitals.

As discussed earlier, there is considerable interest on the part of policymakers in fostering price competition among health care providers, especially hospitals, as a means of controlling escalating costs. However, the success of such efforts will be limited by the extent to which nonprice rivalry remains the dominant mode of competition among hospitals. Effective cost containment can be achieved only if existing incentives are reordered to make hospitals become more inclined to lower charges in their efforts to attract patients.

Conceptually, the problem of nonprice competition is related to the role of physicians in the market for hospital services. The primary targets of nonprice rivalry are physicians, because hospitals attempt to increase inpatient volume by attracting more doctors to their staffs. Most physicians are not paid directly by the hospital and must therefore be compensated indirectly through the resources made available to them for medical purposes.

Many policy analysts have applauded the growth and development of health maintenance organizations, preferred provider organizations, independent practice associations and other "procompetitive" organizational forms. Such plans typically offer a comprehensive set of health services and contain internal incentives to provide these services in an efficient manner. Consequently, these plans often have cost advantages over more traditional insurance programs and can successfully compete for subscribers on the basis of price. With respect to this analysis, such organizations have an additional advantage. Because physicians who participate in them assume some financial risk for inefficient medical practices, these organizations can shift the focus of competition among hospitals for medical staff away from resource availability. Physicians may become more aware of the cost implications of hospitals' operations and more likely to consider hospitals' charges in selecting institutions with which to affiliate.

These results are not intended to be definitive. The analysis was designed to explore the possible effects of market structure on hospital behavior, to raise questions and generate hypotheses. Ultimately, greater sophistication will be required to analyze the implications of market structure in conjunction with the demand for hospital services. This will involve refining the analysis to address differences in price levels more carefully, to examine the effects of variations in insurance coverage, and to acknowledge patterns of referrals and transfers. As new and more recent data become available, it will be useful to replicate and expand this analysis and to examine how new institutional arrangements are affecting both the competitive process and its outcomes.

Technical Notes

Length-of-stay weighted case-mix indices

The case-mix index used in this analysis is one version of a Laspeyre's index proposed by Rafferty (1972) and reviewed by Hornbrook (1982). It is an attempt to measure with a single number the relative costliness of a hospital's diagnostic mix of patients. Thus, for example, if one hospital has an index of 104 and a second has a value of 108, it is appropriate to conclude that the costs per case of the second hospital will be higher than the first, *ceteris paribus*.

The index uses two basic pieces of information. First, patients are classified according to admitting diagnosis and the proportion of patients assigned to each specific diagnostic category (P_i) is calculated. For each diagnosis, an average length of stay must also be established (L_i) for some baseline group of patients. The index used in this analysis takes the entire HCUP patient sample as its reference group, meaning that average lengths of stay are calculated using all patients in all sample hospitals for the period 1970 to 1977.

The index of a particular hospital j in year t is calculated as follows. Denoting the proportion of patients in this hospital with diagnosis i in a given year by P_{ijt},

$$I_{jt} = 100 * \sum_i L_i P_{ijt} / (\sum_i L_i P_i)$$

Thus, a value of I_{jt} equal to 100 indicates that the expected length of stay in hospital j during year t is identical to the sample average, given its mix of diagnoses. A value of 200 would imply that its mean length of stay should be double the sample average, while a value of 50 indicates it should be one-half. Assuming that length of stay is a reliable indicator of the resources required to treat a particular admission, the index therefore reveals the relative costliness of a hospital's case mix.

Herfindahl Indices of market concentration

The Herfindahl Index is a standard measure of market concentration used in economic analyses. It is based upon the market shares of the firms, in this case hospitals, participating in the production and delivery of goods or services. If there are N hospitals in a particular area and S_i indicates the market share of hospital i, the Herfindahl Index of market concentration is given by

$$H = \sum_{i=1}^{N} S_i^2$$

This index has several useful properties. It ranges in value from zero (most competitive) to one (no competition). The value of the index tends to fall as the number of hospitals in an area increases, indicating that more competition will prevail. Moreover, the index is sensitive to both the number of hospitals in a market and their relative sizes. If one institution has a 90 percent market share, one would be hard pressed to suggest the market is highly competitive, regardless of how many other hospitals operate in the area. To the extent that some hospitals are large, relative to others, the Herfindahl Index will increase for a given N. Thus, the value of H will be smallest if each hospital has the same market share, that is, if the market is as competitive as possible given the number of hospitals involved.

This characteristic suggests an intuitive explanation for the value of H. For identical market shares, the Herfindahl Index will equal $1 / N$. The inverse of H therefore indicates the maximum number of hospitals that could exist in a market with the same degree of competitiveness. For example, consider a three-hospital market in which one hospital has a two-thirds market share and two hospitals each have a one-sixth share. In this case,

$$H = (2/3)^2 + 2(1/6)^2 = 1/2$$

Therefore, this market functions as if the productive capacity of the incumbent hospitals had been reorganized into two identical institutions.

The Herfindahl Index must be defined in terms of some measure of output or capacity. Gross capital stock was used in this analysis, although other variables such as adjusted admissions and short-term beds were considered. Gross capital stock has been used successfully in other analyses of hospital competition and is highly correlated with other reasonable bases for defining market shares. In terms of the three-way classification used here, all monopolistic hospitals had index values of one. Hospitals were classified as competitive if their Herfindahl Index was less than one-fifth since they operate in counties with at least five hospital-equivalents. The intermediate, moderately competitive group had values for this index varying between one-fifth and one.

Table 7. Numbers of hospital-year pairs reporting individual variables, by type of market and hospital control (HCUP Hospital Sample, 1970-1977).

	All hospitals			Public hospitals			Voluntary hospitals		
	All	Competitive	Monopolistic	All	Competitive	Monopolistic	All	Competitive	Monopolistic
Measures and determinants of financial position									
Gross profit margin	2044	718	368	334	20	150	1425	541	202
Net profit margin	1877	650	359	330	26	148	1298	486	196
Aggregate profit margin	1841	631	358	325	27	148	1257	459	195
Operating expenses per adjusted admission	1651	569	295	285	28	124	1113	418	157
Gross revenue per adjusted admission	1802	631	318	306	32	129	1231	462	173
Aggregate measures of utilization and case mix									
Short-term length of stay	2367	866	404	396	53	159	1629	629	227
Operations per short-term admission	2364	866	404	395	53	158	1628	629	226
LOS-weighted index of diagnostic case mix	1912	695	338	318	49	127	1464	586	206
Number of admissions as a percent of total admissions for four common diagnoses									
Acute myocardial infarction	1909	681	338	318	49	127	1461	572	206
Normal delivery	1909	681	338	318	49	127	1461	572	206
Fracture (all sites)	1909	681	338	318	49	127	1461	572	206
Bacterial pneumonia	1909	681	338	318	49	127	1461	572	206
Number of procedures per admission for four common diagnoses									
Acute myocardial infarction	1875	664	334	310	48	126	1438	557	203
Normal delivery	1662	539	330	299	48	123	1286	466	202
Fracture (all sites)	1904	678	338	318	49	127	1457	570	206
Bacterial pneumonia	1886	669	338	318	49	127	1450	563	206
Measures of resources available within hospitals									
Mean excess short-term bed capacity	2063	755	352	352	48	141	1413	548	195
Net Assets per adjusted admission	1737	601	312	279	23	127	1204	448	170
FTE employees per adjusted admission	2034	716	361	337	35	145	1390	520	198
Capital-labor ratio	2047	729	363	330	32	144	1437	550	204

Source: National Center for Health Services Research and Health Care Technology Assessment. Hospital Studies Program.

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